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Glycemic Control and Type 1 Diabetes Mellitus: Current Standard Treatment vs. Closed-Loop Insulin Pumps

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Abstract

- Of 110, 94.7% of the US population had a diagnosis of Diabetes Mellitus (DM). Although most of the data within this study encompassed type 1 (T1) and type 2 (T2) DM data in all ages of patients, the focus of this project will be on T1DM.

- There are effective methods currently available for the management of T1DM patients. These methods include: closed-loop insulin pumps that integrate a continuous glucose sensor (CGM) and insulin pump into one effective system that calculates the needed insulin dose through complicated algorithms, CGM with self-blood glucose monitoring (SBGM) and insulin administration, and SBGM with insulin administration.

- Literature reveals that closed-loop insulin pumps have the potential to provide better glycemic control and the need for disease management for these patients who are motivated to use them as directed and find them a desirable option.

- When patients can effectively manage their blood glucose, and practice healthy lifestyle and dietary choices, they can avoid unnecessary hospitalizations and long-term diabetic complications. This will simultaneously reduce health-related costs, increase longevity and can improve the patient’s quality of life.

INTRODUCTION

- According to the CDC, DM affects 30.3 million people in the US. Five percent of the cases are estimated to be Type 1 Diabetes Mellitus (T1DM), and the incidence of DM is steadily increasing with an estimated 1.1 million new cases of diabetes diagnosed in 2019 alone.

DIABETES MELLITUS type 1

- The DCCT performed by Nathan, D. M., Bayless, M., Cleary, P., Bergenstal, R., Lachin, J., M., Zinman, B. (2013) demonstrated an improvement in the INT group with three events in nine subjects. Beta cell self-preservation – INT group slowed the rate of loss of C-peptide responsiveness by ~50%.

- The DCCT performed by Nathan, D. M., Bayless, M., Cleary, P., Bergenstal, R., Lachin, J., M., Zinman, B. (2013) demonstrated a drop of nearly ~2.5% in HbA1C and a slowed rate of loss in C-peptide responsiveness in Beta cell preservation. The DCCT performed by Nathan, et al. (2013) demonstrated the need for earlier intervention in T1DM by showing that it can reduce severe renal impairment by ~50%, risk of primary CVD outcomes by 42%, and nontaral Ml or stroke by 38%.

- Historical studies show that an intensive insulin regimen along with strict blood glucose levels and glycoylated hemoglobin levels (HgbA1C) and decrease the incidence of hypoglycemic episodes, as compared to the current standard treatment of insulin pump therapy in patients with T1DM.

- What are the unique benefits of the different effective T1DM management methods?

- What are the challenges of these management methods and how will they affect their actual use-effectiveness?

LITERATURE REVIEW

- The DCCT performed by Nathan, M. B., Bayless, M. L., Cleary, P. O., Bergenstal, R. M., Lachin, J. M., Zinman, B. (2013) showed an improvement in the INT group with three events in nine subjects. Closed-loop insulin delivery with usual pump therapy (four weeks each) in 29 adults with well controlled T1DM (HgbA1C <7%). A closed-loop system was used, in which the participants determined the amount of insulin administered before each meal participants had sensor glucose noncompliance in target range (mean 53%) (25.5-135 mg/dL). With usual pump therapy, closed-loop delivery reduced mean glucose concentration by 0.2 mmol/L (±1.2, p=0.002), the proportion of time with glucose concentration above 10 mmol/L by 6.9 percentage points (±1.3, 3.5-10.9, p<0.001). Compared with usual pump therapy, closed-loop delivery reduced mean glucose concentration by 0.4 mmol/L (±1.2, p=0.002) and by 9.3 percentage points (5.1-5.0, p=0.002) and below 5.0 mmol/L (±0.4, p<0.001) and glyceremic dispersion (w, SD of glucose concentration) by 0.95 mmol/L (±0.87, p=0.01).

- Literatures reveal that closed-loop insulin pumps are the potential to provide better glycemic control and decreased disease management outcomes for these patients who are motivated to use them as directed and find them a desirable option.

- When patients can effectively manage their blood glucose, and practice healthy lifestyle and dietary choices, they can avoid unnecessary hospitalizations and long-term diabetic complications. This will simultaneously reduce health-related costs, increase longevity and can improve the patient’s quality of life. 

RESEARCH QUESTIONS

- Will closed-loop insulin pumps provide better efficacy by monitoring glycemic control according to patient’s blood glucose levels and glycoylated hemoglobin levels (HgbA1C) and decrease the incidence of hypoglycemic episodes, as compared to the current standard treatment of insulin pump therapy in patients with T1DM?

- What are the unique benefits of the different effective T1DM management methods?

- What are the challenges of these management methods and how will they affect their actual use-effectiveness?

APPLICATION TO CLINICAL PRACTICE

- Initial management of a T1DM patient should include basic disease education, demonstration of insulin injections and how to recognize and treat a hypoglycemic episode, and how to manage either blood or urine ketones consistent with the physician or diabetes support team. T1DM patients should ideally include an endocrinologist, a certified nurse educator, dietitian, and possibly a mental health professional to provide support if the need arises.

- As potential future family practice providers, we must consider our patient’s lifestyle, education and finances to determine what insulin treatment option would be the most effective.

- In addition, the closed-loop systems should be strongly considered as a long-term management method in patients with T1DM.

REFERENCES


ACKNOWLEDGEMENTS

I would like to give a very special thank you to Alvin Kag, PhD, Barb West, AN-BC, Professor Daryn Kag, PA-C, Dawn Hackman, and the UND writing center for all their hard work and dedication in helping me to develop and proficiently write this scholarly project. Your time, help and expertise is greatly appreciated, and has not went unnoticed. I also would like to take time to thank the UND Physician Assistant program faculty for their commitment to providing a quality education and for providing exceptional guidance throughout my endeavors in the PA program.